Ultrasonic material thickness gauge

TU-US

PROFESSIONAL MEASURING

English version

Operating instructions Ultrasonic material thickness gauge

Version	3.0
	2024-05
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	TU_US-BA-e-2430

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SAUTER

English

SAUTER TU-US

Ultrasonic material thickness gauge

Operating instructions Ultrasonic material thickness gauge

Version 3.0 2024-05

Table of contents:

1 Technical data

SAUTER model	TU 80-0.01US	TU 230-0.01US	TU 300-0.01US
Display	128x64 dot matrix LCD display with backlight		
Measuring range	0.75~80mm	1.2~200/230mm	3~200/300mm
Resolution	0.01mm	0.01 / 0.1mm	0.01 / 0.1mm
Measurement uncertainty	±0.5% + 0.04mm		
Sound velocity	1000-9999m/s		
Memory	20 groups (with 100 measured values each)		
Communication	RS-232		
Ambient temperature	-10°C - +60°C		
Max. Air humidity	≤90%		
Power supply	2x 1.5V AA alkaline batteries		
Dimension	132x76x32mm		
Weight	Approx. 345g		

2 Declaration of Conformity

The current EC/EU Declaration of Conformity can be found online at
https://www.kern-sohn.com/shop/de/DOWNLOADS/

3 Overview of the device

3.1 Scope of delivery

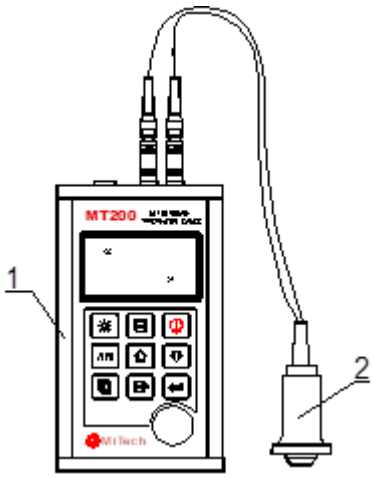
- Operating instructions
- Main body
- Measuring probe (ATU-US10 90°)
- Coupling agent
- Transport case
- Operating instructions
- Screwdriver
- 2x AA alkaline battery

3.2 Accessories available separately

- Measuring probe: ATU-US01
- Measuring probe: ATU-US02
- Measuring probe: ATB-US02
- Data Pro for material thickness gauge
- Communication cable

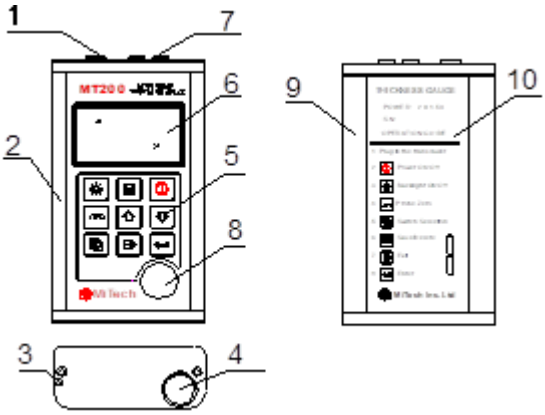
3.3 Components

3.3.1 External device view



Description of the	Function
1	Housing
2	Measuring probe

3.3.2 Parts of the main body



	Description of the
1	Communication socket
2	Aluminium housing
3	Harness mounting hole
4	Battery cover
5	Keypad
6	LCD display
7	Socket for US measuring probe (no polarity)
8	Zero plate for US measuring probe
9	Aluminium housing
10	Explanation of the button symbols

3.4 General functions

A wide range of materials can be measured, including metals, plastics, ceramics, composites, glass and other ultrasonically conductive materials. Four transducers are available for specialised applications, including coarse grained material and high temperature applications.

- Reset function of the measuring probe
- Sound velocity calibration function
- Two-point calibration function
- Two measurement functions: Single measurement and scan mode
- Coupling indicator
- Battery status display
- Auto sleep" and "Auto power off" function to conserve battery power.
- software is available on request to transfer memory data to the PC via USB connection.

3.5 Measuring principle

The digital ultrasonic material thickness gauge measures the thickness of a part or structure by accurately measuring the time it takes for a short ultrasonic pulse, controlled by a probe, to penetrate through the thickness of a material, then reflect off the back or inner surface and be sent back to the probe.

This measured two-way transmission time is divided by 2 (representing the round trip) and then multiplied by the speed of sound of the corresponding material. The result is expressed with the following formula:

H = material thickness of the test object

v = speed of sound of the corresponding material

t = the measured transit time for the sound

4 Basic information (general)

4.1 General information on warning notices

Warnings are used in these operating instructions to warn you of possible personal injury or damage to property in certain situations.

Signal word	Description of the
DANGER	Failure to observe the instructions will lead directly to serious injury, permanent impairment (e.g. loss of a limb) or death of the user or third parties
WARNING	Failure to observe the instructions may result in serious injury, permanent impairment (e.g. loss of a limb) or death of the user or third parties
CAUTION	Failure to observe the instructions may result in minor injuries or temporary damage to the user or third parties (e.g. minor cuts)
NOTE	Failure to observe the instructions may result in damage to property

Symbols in warning notices:

Symbol	Meaning
Warning signs	Warning signs warn you of hazards that may result in personal injury. The symbol indicates the type of hazard.
	Indicates general hazards or a danger point
	Warning of flammable substances
	Warning of explosive substances
	Warning of electrostatically sensitive assemblies

Symbol	Meaning
Command sign	Mandatory signs prescribe measures that you must take to avoid personal injury or damage to property. The symbol indicates the necessary actions or objects to prevent damage.
	Indicates a prescribed action

4.2 Intended use

The TU-US model is a digital ultrasonic material thickness gauge. It is based on the same operating principles as SONAR. The TU-US can be used to measure the thickness of a wide range of materials with an accuracy of up to 0.01mm or 0.001 inch. It can be used for a wide range of metallic and non-metallic materials.
After use, place the appliance and its accessories in the appliance box and store it properly. The device should be stored in a dry and cool environment.
If you have any questions, please contact SAUTER or visit our website www.sauter.eu.

4.3 Improper use

The measuring device is not to be used for medical purposes.
Do not use the device in potentially explosive atmospheres or for measurements in liquids or on live parts. This device is not waterproof and cannot be used in environments with high humidity or water mist. Avoid the ingress of liquids, powders or solid foreign bodies such as water and dust into the measuring opening and the housing.
Unauthorised structural changes, additions or conversions to the device are prohibited. Unauthorised modifications may impair the accuracy of the device or even cause irreversible damage to the device.

4.4 Guarantee

Warranty expires with

- Non-compliance with our specifications in the operating instructions
- Use outside the described applications
- Modifying or opening the device
- Mechanical damage and damage caused by media, liquids, natural wear and tear
- Improper set-up or electrical installation
- Improper assembly or electrical installation

5 Basic warnings and safety instructions

5.1 Observe the notes in the operating instructions

Read the operating instructions carefully before commissioning/using the appliance, even if you already have experience with SAUTER appliances. Always keep the instructions in the immediate vicinity of the appliance.

5.2 Staff training

The appliance may only be used by persons who have read and understood the operating instructions, in particular the chapter on safety.

5.3 Security

⚠ WARNING	
	**Read all safety information and instructions.** Failure to observe the safety information and instructions may result in electric shock, fire and/or serious injury. **Keep all safety information and instructions for future reference.** ● Make sure that there are never people or objects under the load, as they could be injured or damaged! ● The design of the measuring device must not be modified. This can lead to incorrect measurement results, safety-related defects and the destruction of the measuring device. ● Do not operate the appliance in potentially explosive rooms or areas and do not install it there. ● Do not operate the device in an aggressive atmosphere. ● Do not immerse the appliance in water. Do not allow any liquids to penetrate the inside of the appliance. ● The device may only be used in a dry environment and under no circumstances in rain or at a relative humidity above the operating conditions. ● Protect the device from permanent direct sunlight. ● Do not expose the appliance to strong vibrations. ● Do not remove any safety signs, stickers or labels from the appliance. Keep all safety signs, stickers and labels in a legible condition ● Do not open the device

⚠ WARNING

Choking hazard!
Do not leave the packaging material lying around carelessly. It could become a dangerous toy for children.
● The appliance is not a toy and does not belong in the hands of children.
● This appliance can be dangerous if it is used improperly or not as intended by untrained persons! Observe the personnel qualifications!

⚠ WARNING

Improper use of rechargeable or non-rechargeable batteries can cause them to catch fire, explode, emit toxic vapours or release corrosive liquids. The following therefore applies to rechargeable and non-rechargeable batteries:
● Protect from fire and heat.
● Never expose to high pressure or microwaves.
● Do not bring into contact with liquids or chemicals.
● Never bring the electrical contacts of rechargeable batteries and batteries into contact with metal objects or short-circuit them.
● Never modify rechargeable batteries, batteries and chargers.
● Batteries must never be charged.
● Never use or charge a defective, damaged or deformed battery.

CAUTION

● Keep a sufficient distance from heat sources.
● Do not use the device in environments with high humidity or water mist.

NOTE

● To avoid damaging the device, do not expose it to extreme temperatures, extreme humidity or moisture.
● Do not use harsh cleaning agents, abrasive cleaners or solvents to clean the appliance.

6 Transport and storage

6.1 Hint

If you store or transport the device improperly, the device may be damaged. Observe the information on transporting and storing the appliance.

6.2 Transport

When transporting the appliance, use the transport case included in the scope of delivery to protect the appliance from external influences.

6.3 Storage

Observe the following storage conditions when the appliance is not in use:

- dry and protected from frost and heat
- protected from dust ingress in the transport case
- the storage temperature corresponds to the technical data
- Do not expose to vibrations or strong magnetic fields

6.4 Packaging/return transport

Returns are only possible within the limits of the general terms and conditions Keep all parts of the original packaging for any necessary return transport.

- Only the original packaging is to be used for return transport
- Disconnect all connected cables and loose/movable parts before dispatch
- Reattach any transport locks provided
- Secure all parts against slipping and damage

7 Unpacking and commissioning

7.1 Unpacking

In the event of a return, please observe the instructions in the chapter "Packaging/return transport

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On receipt of the appliance, you should first check that no damage has occurred in transit, that the outer packaging, the housing, other parts or even the appliance itself have not been damaged. If any damage is evident, please notify SAUTER GmbH immediately.

7.2 Commissioning

7.2.1 Selection of the measuring probe

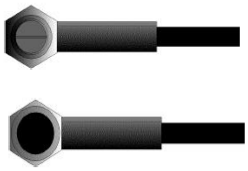
This device can be used to measure a wide range of materials, from various metals to glass and plastic. Different measuring probes, i.e. US measuring heads, are therefore required for different types of material. The correct measuring probe is crucial for reliable measurement success. The following sections explain the important characteristics of the probe and what should be considered when selecting a probe for a specific work object.
In general terms, this means that the best probe for a work object should transmit sufficient ultrasonic energy into the material to be measured so that a strong, stable echo arrives at the instrument. Certain factors influence the strength of the ultrasound as it is transmitted.

These can be found below:

- The initial signal strength: The stronger a signal is from the start, the stronger the returning echo will be. The initial signal strength is mainly a factor of the size of the ultrasonic emitter in the probe. A strong emitting surface will emit more energy into the material than a weak one. Consequently, a so-called "1/2 inch" US probe will emit a stronger signal than a "1/4 inch" US probe.
- Absorption capacity and scattering: When ultrasound flows through a material, it is partially absorbed. In materials with a granular structure, the sound waves scatter. Both of these influences reduce the strength of the sound waves and therefore the ability of the device to recognise or pick up the returning echo. Sound waves with higher frequencies are "swallowed" more than those with lower frequencies. However, a probe with a low frequency is less alignable (focussed) than one with high frequencies. Consequently, a high frequency probe would be the better choice for detecting small pits or impurities in the material.
- Geometry of the measuring probe: The physical limits of the measuring environment sometimes determine the suitability of the measuring probe for a

particular test object. Some probes are too large to be used in a fixed environment. If the surface available for contact with the probe is limited, a probe with a small contact area is required. If you are measuring a curved surface, for example a drive cylinder wall, the contact surface of the measuring probe must also be adapted to this.

- Temperature of the material: If measurements are taken on exceptionally hot surfaces, high-temperature probes are used. These are designed so that they can be used for special materials and techniques at high temperatures without suffering damage. In addition, care must be taken during "zero calibration" or "calibration at known material thickness" with a high-temperature probe.
- The selection of a suitable measuring probe is often a compromise between different influences and properties. Sometimes it is necessary to try out several probes until you finally find the most suitable one for the test object in question.
- The measuring probe is the "end piece" of the measuring device. The probe transmits and receives ultrasonic waves, which the device uses to measure the thickness of the material being analysed. The measuring probe is connected to the measuring device by an adapter cable and two coaxial connections.
- The measuring probe must be used correctly in order to obtain accurate, reliable measurement results.



The top illustration shows the bottom view of a typical measuring probe. The two semicircles are visibly divided in the centre. One of the semicircles guides the ultrasound into the material to be measured and the other guides the echo back to the measuring probe. If the measuring probe is placed on the material to be measured, it is located directly under the centre of the area whose thickness is to be measured.
The picture below shows the top view of a measuring probe. The measuring probe is pressed from above with the thumb or index finger in order to position it precisely.

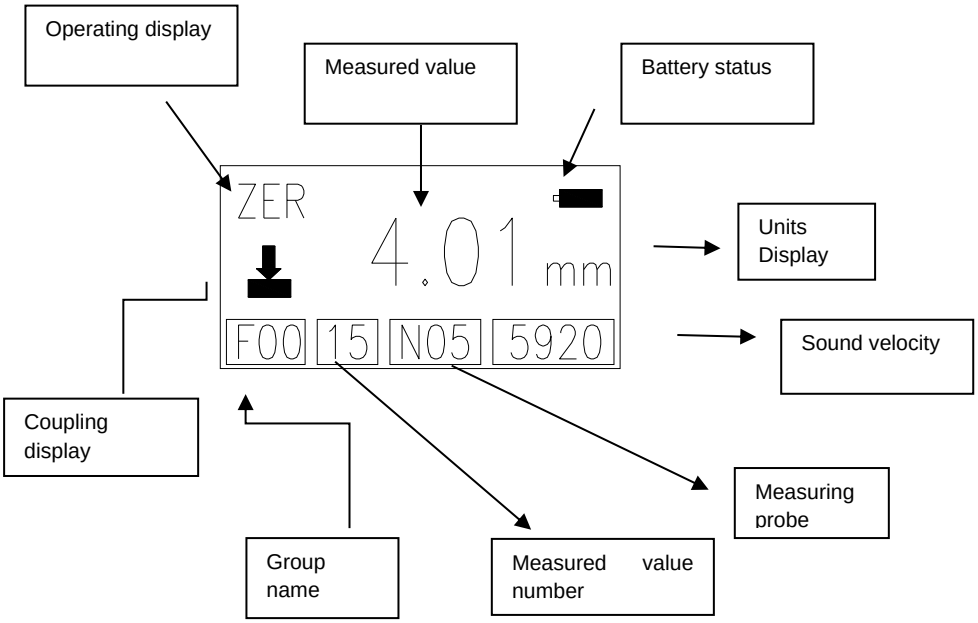
Model	Freq MHZ	Diameter mm	Measuring range	Lower limit	Description
ATU-US01	2	22	3.0mm～300.0mm (steel) 40mm (cast iron)	20	For thick, highly damping or highly scattering materials
ATU-US09	5	10	1.2mm～230.0mm (steel)	Φ20mm×3.0mm	Normal measurement
ATU-US10 /90°	5	10	1.2mm～230.0mm (steel)	Φ20mm×3.0mm	Normal measurement
ATU-US02	7	6	0.75mm～80.0mm (steel)	Φ15mm×2.0mm	For thin or slightly bent pipe material
ATB-US02	5	14	3～200mm (steel)	30	High temperature measurements (<300°C)

7.2.2 Conditions and preparations for surfaces

With any type of ultrasonic measurement, the quality and roughness of the surface to be measured is of the utmost importance. Rough, uneven surfaces can
restrict the penetration of the ultrasonic waves through the material, resulting in unstable, incorrect measurement results.
The surface to be measured should be clean and free of any substances, rust or verdigris. If this is the case, the measuring probe cannot be clean.
be placed on the surface. A wire brush or scraper is often helpful to clean the surface. In extreme cases, belt sanders or the like can be used. However, gouging of the surface must be avoided, which prevents clean placement of the measuring probe.
Extremely rough surfaces such as cast iron are very difficult to measure. These types of surfaces behave like when light shines on frosted glass, the beam is scattered and sent in all directions.
In addition, rough surfaces contribute to considerable wear of the measuring probe. They should therefore be checked at a certain distance, especially at the first signs of unevenness on the contact surface. If this is more worn on one side than the other, the sound waves can no longer penetrate vertically through the material surface of the test object. In this case, small irregularities in the material are difficult to measure as the sound beam is no longer exactly under the probe.

8 Menu

8.1 Menu display



Function	Description of the
Battery indicator	Battery status display
Coupling display	Displays the pairing status; This symbol must appear during the measurement. If this is not the case, it is not possible to measure.
Operating display	Indicates whether the device is switched on
FIL	Group number
PRB	Measuring probe active
VEL	Sound velocity change
CAL	Calibration of the speed of sound
DPC	Two-point calibration status
ZER	Zero calibration of the measuring probe
SCA	Shows status scan mode (on/off)
Group name	Number of the current group
Measured value	Number: displays the consecutive number
Measuring probes	The selected measuring probe is displayed. • ATU-US01: N02 • ATB-US06: N05 • ATU-US02: N07 • ATB-US02: HT5

Speed of sound	Displays the current speed of sound
Measured value	The measured value appears on the display. ↑ Upper measurement limit has been reached ↓ Lower measurement limit was reached
Unit display	When the **mm** symbol lights up, the material thickness is measured in mm and the sound velocity in **m/s.** If the **inch symbol appears, the material thickness is** measured in inches and the sound velocity in **inches/s.**

8.2 Description of the control panel

	Switching the device on and off		Abandonment the current selection
	Switching the backlight on and off		Enter button
	US measuring probe Zero setting		roll forward
	Switch between the entries		Roll back
	Save data or Delete data		

8.3 Navigation in the menu

The presetting of the parameters and the additional function are realised via the menu operation. The main menu can be accessed using the button.

8.3.1 Access to the main menu ü

Use the button to access the main menu and to exit it again.

8.3.2 Access to the submenu ü

Use the button to access the submenu.

8.3.3 The parameters change

Press the button to change the value of the parameter on the display set to Parameter.

8.3.4 Numerical digital input

Press the button several times to access the number to be changed; use the buttons and to increase or decrease the numerical value on the display to the desired numerical value.

8.3.5 Saving and exiting the menu

Press to confirm any changes and return to the previous screen page.

8.3.6 Deleting and exiting the menu

Press to delete any changes and return to the previous screen page.

9 Basic operation

9.1 Switching on and off

When the device is switched on for the very first time, the model type, manufacturer information and serial number are displayed before the screen for the measurements appears. The device has a special memory in which all measurements are stored, even after switching off.

9.2 Selection of the measuring probe

The measuring probe must be "pre-set" before the measurement. This serves as an additional aid and enables the user to select the correct probe for the measurement requirements (depending on frequency and diameter) between the individual models.

1. Press the button (bottom left) on the control panel several times to select the measuring probe.
2. Use the button or the button to display the different models.
3. To exit, press the button. The probe setting can also be changed in the menu.

9.3 Zero setting

Set the correct probe via the "Select probe" menu. Set the sound velocity to 5920 m/s². The button is used to zero the measuring device. If this is not done correctly, all measurements taken may be incorrect. When the device detects the zero setting, the specified error value is measured and automatically corrected for all subsequent measurements.
The procedure is as follows:

1. The device must be switched on and the two-point calibration must be inactive. The
   Zero setting is not possible.
2. The measuring probe is plugged in and the plug connections are checked. The contact surface of the measuring probe must be clean.
3. The measuring probe currently in use is displayed in the device.
4. A drop of coupling agent is now added to the metal zero plate.
5. The measuring probe is carefully pressed onto the zero plate.
6. A progress bar starts to run from left to right. When it reaches the right, an acoustic signal sounds and the zero setting is complete.
7. Lift measuring probe, measuring device automatically switches to measuring mode

The device has now recognised the initial error factor and will compare all subsequent measurements with it. When zeroing, the device will always use the sound velocity of the built-in zero plate, even if other values were previously entered in order to take current measurements.
Although the last zero setting is saved, it is recommended that it is carried out again each time the device is switched on, as well as when a different measuring probe is

used. This ensures that the device is always set correctly. Pressing the button cancels the current zero setting.

9.4 Speed of sound

In order to be able to take exact measurements, this must be set to the speed of sound of the corresponding material. Different materials have different speeds of sound.
If this is not done, all measurements will be incorrect by a certain percentage. **Single-point calibration** is the most common method of optimising linearity over a long range. **Two-point calibration** allows greater accuracy at shorter ranges by calculating the zero setting and the speed of sound.
Note: For **single-point and two-point calibrations,** colour or coating must be removed beforehand. If this is not done, the calibration result will consist of a type of "multi-material sound velocities" and will certainly not be that of the actual material to be measured.

9.4.1 Calibration with known material thickness

Note: This procedure requires a material sample of the material to be measured, the exact material thickness of which is to be measured, e.g. on any
type was previously measured.

1. The zero setting is made.
2. The sample material is provided with coupling gel.
3. The measuring probe is pressed onto the piece of material. A material thickness value is now shown on the display and the coupling symbol appears.
4. As soon as a stable reading is reached, the measuring probe is lifted again. If the material thickness just determined then changes from the value that existed during coupling, step 3 must be repeated.
5. The required material thickness (that of the material pattern) can now be adjusted using the buttons , and .
6. Press the button and the calculated sound velocity value appears based on the material thickness that was previously saved.
7. The device automatically switches to measuring mode

9.4.2 Calibration with known sound velocity

Note: For this procedure, the speed of sound of the material to be measured must be known. A table of the most common materials can be found in the appendix of these operating instructions.

1. Press the button several times to access the "Speed of sound" element.
2. Use the button to switch between the preset sound velocities.
3. If necessary, the preset sonic velocity can be overwritten up and down using the buttons and until the desired value of the material to be measured is reached. This is necessary, for example, if, as already mentioned, there are deviations in the material composition from (manufacturer to manufacturer) for one and the same material.
4. To exit calibration mode, press the button. Measurements can now be taken.

Another method of calibrating the device with a known speed of sound is as follows:

1. Go to the {Test Set} → {Velocity Set} submenu and press the button to access the sound velocity menu.
2. The button is pressed several times until the changeable numerical digit is reached. Use the / buttons to change the numerical value up or down until it corresponds to the speed of sound of the material to be tested.
3. An automatic repeat function is built into the device; if the button is held down, the numerical values add up or decrease in steps at the same interval.
4. Press the button to confirm or the button to cancel the calibration.
5. In order to achieve the most accurate measurement result possible, it is generally recommended to calibrate the measuring device with a material sample of known thickness.

The material composition itself (and therefore the speed of sound) often varies from one manufacturer to another. Calibration with a material sample of known thickness ensures that the measuring device has been adjusted as accurately as possible to the material to be measured.

9.5 Measurements

The measuring device always saves the last measured value until a new value is added.
For the measuring probe to function properly, there must be no air bridges between its contact surface and the surface of the material to be measured. This is achieved with the ultrasonic gel, the "coupling agent". This liquid "couples" or transmits the ultrasonic waves from the probe into the material and back again. A little coupling agent should therefore be applied to the surface of the material to be measured before the measurement. The measuring probe is then carefully pressed onto the material surface. The coupling symbol and a number appear on the display. Once the device has been set and the correct sound velocity has been determined, the number on the display shows the current material thickness measured directly under the measuring probe.
If the coupling indicator does not appear or the number on the display is questionable, first check whether there is sufficient coupling agent in the area under the measuring probe and whether it has been placed flat on the material. Sometimes it is necessary to try a different probe for the material in question (diameter or frequency).
While the measuring probe is in contact with the material to be measured, four measurements are taken per second. If it is lifted from the surface, the last measurement remains on the display.

Note: Sometimes a thin film of coupling agent is drawn between the measuring probe and the material surface when the measuring probe is lifted. This film can cause the measurement to be larger or smaller. In the case of materials with a thick colour or coating, this can be measured by mistake instead of the intended material. The user is responsible for the proper use of the measuring device in connection with recognising these phenomena.

9.6 Two-point calibration

This procedure assumes that the user has two known material thickness points of the test material and that these are representative of the measuring range.

1. Coupling agent is applied to the material sample.
2. The US measuring probe is placed on it and the correct position of the measuring probe on the material sample is checked. A measured value should now be shown on the display and the coupling symbol should appear.
3. As soon as a stable measured value is reached, the measuring probe is removed. If the reading differs from the reading when the measuring probe was still coupled, step 2 must be repeated.
4. The measurement of the material thickness is changed up and down using the buttons , and until the value of the material pattern is set.
5. To set the 2nd value, press the ZERO button. The device switches to measuring mode. The 2nd sample is now measured (the thickness should be different to the 2nd sample, otherwise an error message will be displayed)
6. As soon as a stable measured value is reached, the measuring probe is removed. If the reading differs from the reading when the measuring probe was still coupled, step 2 must be repeated.
7. Press the button, the input screen appears, adjust the nominal thickness here.
8. The measurement of the material thickness is changed up and down using the buttons , and until the value of the material pattern is set.
9. End the 2-point calibration with the button or cancel with the button.
10. The device is now ready to take measurements in its measuring range.

9.7 The scan mode

This device has a scan mode. In normal mode, four measurements are taken per second, which is very useful for individual measurements. In scan mode, ten measurements are taken per second and the reading results are shown on the display. While the measuring probe is in contact with the material to be measured, the device automatically displays the measured value. The measuring probe can be moved over the surface, as short interruptions to the signal are ignored. In the event of interruptions lasting longer than two seconds, the last measured value found is displayed. If the measuring probe is lifted, the last measured value found is also displayed.

In the {Test Set} → {Work Mode} menu, press the button to switch between single-point measurement mode and scan mode.

9.8 Set limit value

This allows the user to set an audible and visible parameter during the measurement. If a measurement is beyond the limit value set by the user, a signal tone sounds. This improves the speed and effectiveness of the measurements as it is not necessary to constantly look at the display.

The following section describes how to create this option:

1. In the {Test Set} → {Tolerance Limit} menu, press the button to activate the command.
2. Use the button and the and buttons to set the upper and lower limit values for the desired measured value.
3. Press thebutton again to confirm and go to the actual menu or press the button to cancel the limit setting.
4. If the set limit exceeds the measuring range, the measuring device will remind you to reset it. If the lower limit is greater than the upper limit, the values are automatically exchanged.

9.9 Resolution

The device has two selectable screen resolutions: 0.1mm and 0.01mm. These can be found in the menu under {Test Set} → {Resolution}.

The button can be used to select between "high" (high resolution) and "low" (low resolution).

9.10 Unit scale

In the {Test Set} → {Unit} menu, use the button to select between mm (metric) and inches (English).

9.11 Storage management

9.11.1 Saving a measured value

The measured values can be stored in 100 groups (F00-F99) in the device and 100 measured values can be stored in each group.

The procedure is as follows:

1. Press the button to call up the {File **name}** menu on the display.
2. The corresponding group can be selected using the buttons and .
3. After a new reading appears, press the save button to save the measurement in the current file. With the **{Auto Save}** function, the measured value is automatically saved in the file as soon as a new measurement is added.

9.11.2 Edit measured values

Press the button several times until {File name} appears on the display. The group number can be changed using the and buttons.

Deletes the selected group

Deletes all groups

or marks the selected group to save in it

Leave dialogue

*F00	4/100
F01	0/100
F02	0/100
F03	0/100
F04	0/100
F05	0/100

Press the button several times until {Record count} appears on the display. The group number can be changed using the and buttons.

Deletes the selected measured value

Deletes all measured values

or leave dialogue

No.1	12.00mm
No.2	18.95mm
No.3	23.94mm
No.4	29.95mm

9.12 System setting

From the main menu, press the button in the {System Set} submenu.

1. If {Auto Save} is set to <On>, the data of the current file can be saved automatically after the measurement.
2. If {Key Sound} is set to <On>, the buzzer emits a short acoustic signal each time a key is pressed.
3. If {Warn Sound} is set to <On>, you will hear a long beep every time the tolerance limit is exceeded.
4. LCD picture brightness setting: In the {System Set} → {LCD-Brightness} submenu, press the button. Use the arrows and to increase or decrease the display brightness. Press to confirm the changes or to cancel them.
5. In the {Unit System} menu, you can switch between metric and imperial units of measurement.
6. I m Menu {Date/Time} the internal system time can be set.
7. The different languages can be set in the {Language} menu.

9.13 System information

This function provides the most important information about the main part of the device and the firmware. The version changes when the firmware changes.

9.14 Backlit display

This also allows you to work in dark surroundings. The backlight is activated and deactivated with the button as soon as the measuring device is switched on. As the EL light consumes a lot of power, it should only be switched on when required.

9.15 Auto Power Off

The Auto Power Off function can be set here. It can be selected between Off, 2 minutes, 5 minutes and 10 minutes.

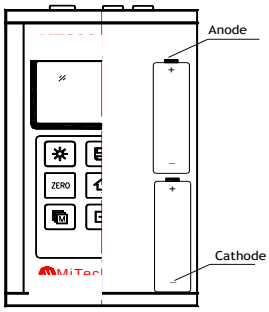
9.16 System reset

If the button is pressed during device start-up or {System reset} is selected in the menu, all settings and the memory are deleted and reset to the default settings.

9.17 Battery information

Two AA alkaline batteries are required as a power source. After using the batteries for several hours, the symbol appears on the display. The larger the black part of the symbol, the fuller the battery is. When the battery capacity is exhausted, the following symbol appears and starts to flash. The batteries should now be replaced.
The picture on the next page shows the position of the batteries in the appliance. It is essential to observe the polarity when changing the batteries.
Procedure:

1. Switch off the device.
2. Remove the battery cover from the device and take out the two batteries.
3. The batteries are inserted correctly.
4. The battery cover is replaced.
5. The appliance is switched on again for checking.



If the appliance is not to be used for a longer period of time, the batteries should be removed.
It is recommended to replace the batteries when the capacity is only 10%.

10 Battery operation / power supply

⚠ WARNING

Risk of fire and explosion due to incorrect charging or defective battery

Fire or explosion can lead to serious injuries

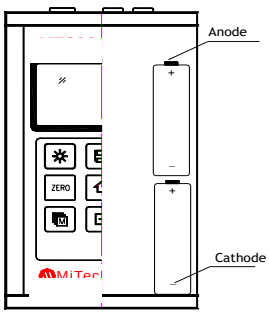
- ⇨ Be sure to observe the notes on rechargeable batteries and batteries in the Safety chapter.
- ⇨ Observe the national and international transport regulations for devices with a permanently installed lithium-ion battery.
- ⇨ Do not replace defective batteries yourself! Contact SAUTER or a specialist dealer directly.

This device is equipped with two AA alkaline batteries. Please use the original battery and do not replace any other batteries to avoid damage to the device or other failures.

- Nominal voltage 1;5 V
- Capacity 3,000 mAh

When the battery capacity is exhausted, the following symbol appears and starts to flash.
It is essential to observe the polarity when changing.
Procedure:

1. Switch off the device.
2. Remove the battery cover from the device and remove the two batteries.
3. Insert the batteries correctly.
4. Replace the battery cover.
5. Switch the appliance on again to check.



If the appliance is not to be used for a longer period of time, the batteries should be removed.
It is recommended to replace the batteries when the capacity is only 10%.

11 Interfaces

The device is equipped with a USB 2.0 interface as standard. It can be connected to a PC using the optional cable. The measurement data stored in the device memory can be transferred via this cable.
For detailed information on the communication software, please read the software manual.

12 Maintenance, servicing and disposal

Disconnect the appliance from the power supply before carrying out any maintenance, cleaning or repair work.

12.1 Cleaning

Clean the device with a damp, soft, lint-free cloth. Ensure that no moisture penetrates the housing. Do not use sprays, solvents, alcohol-based cleaners or abrasive cleaners, but only clear water to moisten the cloth.

12.2 Maintenance and repair

Do not make any changes to the appliance and do not install any spare parts. Contact the manufacturer for repair or device inspection.

12.3 Waste disposal

Old appliances and accessories should not be disposed of with household waste.

The operator must dispose of the packaging and appliance in accordance with the applicable national or regional legislation at the place of use.

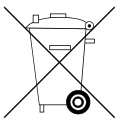
The device consists of various components and materials, such as

- Electronic components (circuit boards, electrical cables)
- Plastic (housing)
- Metal

Improper disposal of the appliance can have harmful effects on people and the environment.

Proper and environmentally friendly disposal can prevent harmful effects and recover raw materials.

Disposal of rechargeable batteries and batteries:



Rechargeable batteries and batteries do not belong in household waste.

The disposal of rechargeable batteries and batteries must be carried out by the operator in accordance with the applicable national or regional law of the place of use.

13 Battery law

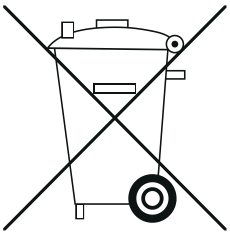
Note in accordance with the Battery Act - BattG:

INFORMATION

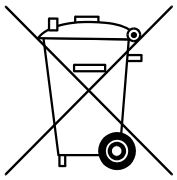
- The following information is valid for Germany.

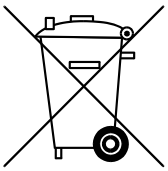
In connection with the sale of batteries and rechargeable batteries, we are obliged as a dealer under the Battery Act to inform end users of the following:

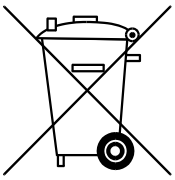
- End users are legally obliged to return used batteries and rechargeable batteries.
- After use, batteries and rechargeable batteries can be returned free of charge to municipal collection centres or retailers. The batteries/rechargeable batteries must have reached the end of their normal service life, otherwise precautions must be taken against short circuits.
- The return option is limited to batteries and rechargeable batteries of the type that we carry or have carried in our range and to the quantity that end users usually dispose of.
- A crossed-out wheelie bin means that you must not dispose of batteries or rechargeable batteries in household waste. Old batteries or rechargeable batteries may contain harmful substances that can damage people and the environment if not disposed of correctly.



- Batteries containing harmful substances are labelled with a symbol consisting of a crossed-out dustbin and the chemical symbol (Cd = cadmium, Hg = mercury, or Pb = lead) of the heavy metal that is decisive for the classification as containing harmful substances.


Cd


Hg


Pb

14 Appendix

14.1 Sound velocities

Material	Sound Velocity	
	In/us	m/s
Aluminium	0.250	6340-6400
Conventional steel	0.233	5920
Stainless steel	0.226	5740
brass	0.173	4399
Copper	0.186	4720
Iron	0.233	5930
Cast iron	0.173-0.229	4400-5820
Lead	0.094	2400
Nylon	0.105	2680
silver	0.142	3607
Gold	0.128	3251
Zinc	0.164	4170
Titanium	0.236	5990
Epoxy resin	0.100	2540
Ice	0.157	3988
Nickel	0.222	5639
Perspex	0.106	2692
Styrofoam	0.092	2337
Porcelain	0.230	5842
PVC	0.094	2388
Quartz glass	0.222	5639
Rubber	0.091	2311
Teflon	0.056	1422
Water	0.058	1473

14.2 Comments on the application

14.2.1 Measuring pipes and hose material

If a piece of pipe is measured to determine the thickness of the pipe wall, the positioning of the measuring probe is important. If the diameter of the pipe is greater than
4 inches, the position of the measuring probe on the pipe should be such that the incision on the contact surface is perpendicular to the long axis of the pipe.
For smaller pipe diameters, two measurements should be taken at the same point, one with the incision on the contact surface perpendicular to the long axis and the other parallel to it. The smaller measured value of these two measurements is then taken as the exact measured value for this point.

Perpendicular Parallel

14.2.2 Measuring hot surfaces

The speed of sound through a particular material depends on its temperature. As the temperature increases, the speed of sound decreases.
For most applications with a surface temperature of less than 100°C, no further precautions need to be taken. At temperatures above this, the change in the speed of sound of the material to be measured begins to have a noticeable effect on the ultrasonic measurement.
At such high temperatures, it is recommended to first perform a calibration with a material sample of known thickness that corresponds exactly or approximately to the temperature of the material to be measured. This allows the measuring device to calculate the exact speed of sound through the hot material.
For measurements on hot surfaces, it may also be necessary to use a "high temperature probe". These are specially designed for use at high temperatures, especially as contact with the material surface should be maintained for a short time to ensure a stable measurement.
While the measuring probe is in direct contact with the hot surface, it heats up. Due to thermal expansion and other effects, this can have a detrimental effect on the measurement accuracy.

14.2.3 Measuring coated materials

Coated materials are special because their density (and therefore the speed of sound) can vary considerably from one piece to another.
Noticeable differences in the speed of sound can be detected even through a single surface. The only way to obtain an accurate measurement result is to carry out a calibration on a material sample of known thickness beforehand. Ideally, this should be made from the same piece as the material to be measured, or at least from the same production series. With the help of "pre-calibration", deviations are reduced to a minimum.

An additional important factor when measuring coated materials is that any trapped air gap causes premature reflection of the ultrasonic beam. This is noticeable in a sudden decrease in material thickness. Whilst this prevents the accurate measurement of the overall material thickness, the user is positively alerted to air gaps in the coating.

14.2.4 Material suitability

Ultrasonic material thickness measurements are based on sending sound through the material to be measured. Not all materials are suitable. Ultrasonic measurement can be practically applied to a variety of materials including metals, plastics and glass. Difficult materials include some cast materials, concrete, wood, fibreglass and some types of rubber.

14.2.5 Coupling agent

All ultrasonic applications require a medium to transmit the sound from the probe to the test material. Typically, this is a very viscous medium.
Ultrasound cannot be transmitted efficiently through air.
A variety of coupling agents are used. Propylene glycol is suitable for most applications. Glycerine is suitable for difficult applications. However, glycerine causes corrosion in some metals due to water absorption.
Other coupling agents for measurements at normal temperatures can include water, various oils or greases, gels and silicone fluids. Measurements at high temperatures require special high-temperature coupling agents.
A characteristic of ultrasonic measurement is that the device uses the second rather than the first echo from the rear surface of the material to be measured when it is in standard pulse echo mode. This results in a reading that is **twice as** large as it should be.
The user is solely responsible for the appropriate use of the measuring device and for recognising these phenomena.